Coastal Observation Technology System Progress Report – June 2006

Project Title: **Enhancements to the Coastal Ocean Monitoring and Prediction System for West Florida: A Component of The Integrated Ocean Observing System**

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Recipient Institution: University of South Florida College of Marine Science

Co-Principal Investigators: Mark E. Luther and Robert H. Weisberg

Primary Contact: Mark E. Luther, USF College of Marine Science, 140 Seventh Ave. S., St. Petersburg, FL 33701; Tel: 727-553-1528; Fax: 727-553-1189; E-mail: luther@marine.usf.edu
Project Web site: http://comps.marine.usf.edu

Summary: We continue to expand our efforts on the Coastal Ocean Monitoring and Prediction System (COMPS) for the west coast of Florida. We continue to maintain and add to our existing coastal ocean observing system, analyze the data being generated, and disseminate these data and their scientific findings in accordance with the developing protocols and standards of the Integrated Ocean Observing System. Additionally, our program on *in-situ* data collection is strongly linked with a parallel modeling activity, and while the support for modeling is not included in this grant, our work is enriched by the modeling activities. For instance, siting arguments for new measurement locations are strongly tied to the modeling activities. All of the data acquisitions are available in near real time on the Internet, and the standards and protocols for sharing and archiving of data in support of the Integrated Ocean Observing Systems are followed.   COMPS data and model products are reported on the Internet at http://comps.marine.usf.edu. All real time data are made available to the NDBC and the NOS for QA/QC and for dissemination via the NOAA gateway. OpenDAP access is in place for all data from our real time systems. Our goal is to have transparent data sharing for use by a broad range of government, private sector, and academic users. Some immediate applications are to the study of Harmful Algal Blooms (HABS) and other ecological concerns, and for providing assistance in maritime operations, emergency preparedness, hazardous spill response, and search and rescue. Data and information products from COMPS are served to these user communities via the web in NetCDF and OpenGIS formats. We are partners in the emerging Regional Associations for both the Southeastern and Gulf of Mexico regions. COMPS is and will remain a building block of the Regional Coastal Ocean Observing Systems for both these regions.

Accomplishments:
-        Increased volume of marine observations in the West Florida coastal ocean by piping buoy and coastal tower observations to NDBC for ingestion into the NOAA system
-        Maintained CODAR array for surface current mapping: Sites at Naples and Indian Rocks Beach are in operation. The site at Venice Beach (owned by and operated jointly with Rutgers and Mote) was severely damaged by lightning this summer. Efforts are being made to repair it.

Another CODAR system has been purchased to serve as spare/back-up for operational systems.

- Successfully developed and disseminated data and information products to end users for storm surge, maritime transportation, search and rescue, hazardous material spill response, and harmful algal bloom monitoring
- Maintained OpenDAP server for data, metadata, and data product exchange and distribution
- Continued and expanded partnerships with educational outreach entities (COSEE, EDL, others)
- Continued partnership with Everglades National Park to upgrade their water level observing sites with satellite telemetry, improved datum control, for inclusion into COMPS data stream
- Established partnership with Florida Department of Environmental Protection Coastal Aquatic Managed Areas to integrate their monitoring data into COMPS and IOOS
- Participated in GCOOS and SECOORA data integration efforts

The principal investigators (Weisberg and Luther) each take primary responsibilities for certain aspects of COMPS. Luther has primary responsibility for the water level and meteorological stations positioned along the coastline and for the Physical Oceanographic Real Time System (PORTS) in Tampa Bay, including Tampa Bay nowcast/forecast modeling. Weisberg has primary responsibility for the oceanographic and meteorological measurements on the adjacent WFS, including the WFS modeling activities. We share common technical support and data management personnel to ensure a coordinated program. We are also co-Principal Investigators on related projects such as the Southeast Atlantic Coastal Ocean Observing System (SEACOOS), which is closely integrated with COMPS. COMPS and SEACOOS are potential components of the developing Integrated Ocean Observing System for US coastal waters. We are participating in the organization of both the Southeast Coastal Ocean Observation Regional Association (SECOORA) and the Gulf of Mexico Coastal Ocean Observing System (GCOOS).

We continue to maintain a coordinated coastal ocean observing and modeling system for the west coast of Florida as part of the Coastal Ocean Monitoring and Prediction System (COMPS) and the Southeast Atlantic Coastal Ocean Observing System (SEACOOS). Along with our scientific and service oriented goals we are also working toward the design of a regional coastal ocean observing system (RCOOS) to be part of the evolving SECOORA and GCOOS efforts. Thus our NOAA COTS activities, joint with our COMPS and SEACOOS activities, are inherently interactive with other projects relating to the west Florida coastal ocean.

Coastal ocean activities over the past year have included maintaining 10 in situ moorings: 6 surface moorings with real time telemetry and 4 subsurface moorings with delayed data access; three long-range HF-radar CODAR sites for surface currents, various satellite data analysis products, and T/S profiling. Challenges included a very active hurricane season and limited ship time to effect repairs. The up side is that we did not lose any measurement systems, and we acquired some spectacular data sets. Along with the data acquisitions we advanced our modeling work along three fronts: 1) linking the coastal ocean with the deep-ocean by nesting a West Florida Shelf (WFS) model (ROMS) into an Atlantic model (the $1/12^{th}$ degree North Atlantic HYCOM); 2) linking the coastal ocean with the estuaries using the Finite Volume Coastal Ocean

Model (FVCOM), with emphasis on the Tampa Bay and Charlotte Harbor estuary interactions with the inner shelf; and 3) focusing on the individual estuaries with very high resolution using the FVCOM. New additions this year have been the acquisition of a Webb Electric Glider (purchased on year 1 funds) and the exercise of BSOP profilers (build using year 1 funds). Also completed this year were sets of spares, as budgeted, and a mooring system for deployment offshore of Panama City, Florida. We advanced our satellite data products by adding multivariate analyses to the original OI analyses for cloud-free SST and ocean color and by adding Lagrangian trajectory analyses to our SSH and geostrophic current analyses. Hence progress has been made on all fronts, and all of these activities and data are available on the Web.

Some deviations to the original plans were made consistent with our RCOOS development goals. First, we did not deploy a fourth CODAR system at Cedar Key. The system was purchased and site evaluations were pursued. However, based on our evolving experience with these systems we opted to use the new one as a spare in the event of lightning or other malfunctions, and this turned out to be prudent in view of the past hurricane season. Second, we decided to forego the acquisition of a wave-rider buoy, concentrating instead of developing our near shore wave capabilities offshore of both Pass-a-Grille channel and New Pass. Successful deployments were accomplished at both locations using RD-Instruments and Nortek wave ADCPs and in situ processors, along with acoustic underwater telemetry from underwater measurement sites to surface platforms (a buoy at New Pass and a fixed channel marker at Pass-a-Grille) and radio telemetry from these platforms to shore. In both cases our pioneering work with these private companies will be beneficial to the larger COOS community. We believe that these deviations enhanced, rather than detracted from, our RCOOS development goals.

We completed construction of a new water quality and stream flow monitoring site on Booker Creek, a tributary of Tampa Bay that drains a large urban watershed. This site provides real-time data on water temperature, conductivity, water level, pH and dissolved oxygen, with an acoustic Doppler stream flow gauge and a meteorological tower that measures wind speed, air temperature, humidity, barometric pressure, and precipitation. All data are relayed in real-time to our lab and are posted on the web at http://comps.marine.usf.edu/cpk/. This site is the first stream gauge on the western (Pinellas County) side of the bay. This site is adjacent to Campbell Park Elementary School and the teachers and students participate in its operation. The data from this site and other COMPS sites are relayed to the Educational Distance Learning network (http://www.edlonline.org/) and to a new dedicated web site (http://watershedwatchers.paulineluther.com/) where math and science curricula are built around the real-time data stream. More than 20 teachers from Campbell Park and Baypoint Elementary schools attended an informal workshop April 26, 2006, to learn more about the site and how to incorporate real-time data into their school's curriculum. Additional training and feedback activities for teachers are scheduled for October 2006. We continue to work with staff from the Pier Aquarium, Campbell Park Elementary, and the Pinellas County Schools to develop educational materials and encourage teacher participation.

We have upgraded and hardened most of the coastal water level sites to new Campbell Scientific data acquisition platforms with high data rate GOES transmitters. We have acquired adequate spares to keep these sites in operation and to minimize down time. We continue to

work with our FDEP Bureau of Survey and Mapping to maintain the datum on all our water level sites and with TAMU-CC and NOS to process the tidal datum information from these sites.

The Northwest Florida Bay water level site was destroyed by a direct hit from Hurricane Katrina. We are working with the Florida Institute of Oceanography and other state agencies to obtain funding from FEMA to rebuild this site.

We have enhanced COMPS data management practices by redesigning the web site to a database driven site (http://compsdev1.marine.usf.edu/comps). We have upgraded our data display and data retrieval of COMPS data. The site's front end work is under construction. Presently all our COMPS sites data are accessible in an Open Geospatial Consortium (OGC) compliant manner. We have implemented Web Mapping Application Chameleon which is built on Map Server. Work is also in progress on providing KML files for viewing COMPS site data via Google Earth.

In summary, we advanced our RCOOS goals as planned with some modifications thought to be logical and prudent. In the process, and over the period 2005-present, we published (or submitted) 19 papers in refereed professional journals, produced two doctoral dissertations, two non-refereed publications, and gave 18 presentations at meetings with published abstracts and three other presentations to professional audiences. To this list we also provided numerous presentations to local interest groups as outreach, and provided radio, television, and print media interviews as public service.

Refereed publications

Barth, A. A. Alvera-Azcarate, R.H. Weisberg, and R. He. Hindcast Experiment Nesting a Baroclinic West Florida Shelf Model in a 1/12 degree North Atlantic HYCOM Model. *Journal of Atmospheric and Oceanic Technology*, 2006. submitted.

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Meyers, S., M. Luther, M. Wilson, H. Holm, A. Linville, and K. Sopkin, 2006. A Numerical Simulation of Residual Circulation in Tampa Bay. Part I: Low-Frequency Temporal Variations. *Estuaries* (submitted)

Myzak, C. A., S. W. Campbell, M. E. Luther, R. P. Carnahan, R. J. Murphy, and N. D. Poor, 2005. Below cloud ammonia scavenging in convective thunderstorms at a coastal research site in Tampa, FL, USA. *Atmospheric Environment, 39*, 1575-1584.

Shay, L.K., J. Martinez-Pedraja, T.M. Cook, B.K. Haus, and R.H. Weisberg (2006). High frequency radar mapping of surface currents using WERA, revised to *J. Atm. Ocean Tech.*

Sopkin K., C. Mizak, S. Gilbert, V. Subramanian, M. Luther, and N. Poor, 2006. Modeling Air/Sea Flux Parameters in a Coastal Area: A Comparative Study of Results from the TOGA COARE Model and the NOAA Buoy Model. *Atmospheric Environment,* (accepted)

Virmani, J.I. and R.H. Weisberg (2005). Relative humidity over the west Florida continental shelf. *Mon. Weather Rev.*, 133, 1671–1686.

Virmani, J.I. and R. H. Weisberg (2006). The 2005 hurricane season: An echo of the past or a harbinger of the future? *Geophys. Res. Lett.*, 33, L05707, doi:10.1029/2005GL025517

Walsh, J.J., J.K. Jolliff, B.P. Darrow, J.M. Lenes, S.P Milroy, D.A. Dieterle, K.L. Carder, F.R. Chen, G.A.Vargo, R.H. Weisberg, K.A. Fanning, F. Muller-Karger, K.A. Steidinger, C.A. Heil, J.S. Prospero, T.N. Lee, G.J. Kirkpatrick, T.E. Witledge, D.A. Stockwell, C.R. Tomas, T.A. Villareal, A.E. Jochens, and P.S. Bontempi (2006). Red tides in the Gulf of Mexico: where, when, and why? *J. Geophys. Res.*, submitted.

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Dissertations
Virmani, J. I. (2005). Ocean-atmosphere interactions on the West Florida Shelf. *Ph.D. Dissertation*, College of Marine Science, University of South Florida.

Liu, Y. (2006). Patterns and dynamics of ocean circulation variability on the West Florida Shelf. *Ph.D. Dissertation*, College of Marine Science, University of South Florida.

Non-Refereed Publications
Virmani, J. I., and R. H. Weisberg (2005). Humidity over the West Florida Shelf. *Bull. Am. Met. Soc.*, 86(6), 784-785.

Cole, R., and R. Weisberg (2006). Coastal Ocean Observing Systems Going Wireless. *Sea Tech.*, 47(4), 10-13.

Presentations with published abstracts

Alvera-Azcárate, A., A. Barth, R. He, R.W. Helber, J. Law, and R.H. Weisberg (2005). Derivation of High-Resolution Ocean Surface Fields for Regional and Coastal Models. 2005 AGU Spring Meeting. New Orleans, LA, May 2005.

Barth, A. A. Alvera-Azcárate, R. He, R.W. Helber, R.H. Weisberg (2005). A Hindcast Experiment Nesting a Baroclinic West Florida Shelf Model in the 1/12° Operational North Atlantic HYCOM Model. 2005 AGU Spring Meeting. New Orleans, LA, May 2005.

Barth, A. A. Alvera-Azcarate, R. He, and R. H. Weisberg. A baroclinic, regional west florida shelf model nested in a 1/12 degree north Atlantic Hycom model, inclusive of tides. Honolulu, HI, USA), 2006. Ocean Sciences Meeting.

Cole, R. D., R. H. Weisberg, N. Trenaman and K. Amundsun (2005). COMPS, SEACOOS and NearshoreWaves. MTS/IEEE Oceans 2005, Washington, D.C., April 15-28, 2005.

Holm, H., M. Luther, S. Meyers, J. Seiter, K. Sopkin, M. Wilson, A. Linville, V. Subramanian, and S. Gilbert, 2005. Lagrangian analysis of harmful algal blooms and human pathogens within the Tampa Bay estuary. Presented at the Estuarine Research Federation 18th Biennial Conference, Norfolk, VA, October 2005.

Kirkpatrick. G. et al. Applications of the optical phytoplankton discriminator as an in situ component of an ocean observing system for HAB detection and tracking. Presented at the 18th biennial conference of the Estuarine Research Federation, Norfolk VA., 10/19/05.

Liu, Y. and R.H. Weisberg (2005). On the optimal wind direction in changing the coastal sea level along the West Florida Shelf. Poster presented at the 85th AMS Annual meeting - Sixth Conference on Coastal Atmospheric and Oceanic Prediction and Processes. San Diego, California, January 2005.

Liu, Y., R.H. Weisberg and R. He(2005). Sea surface temperature patterns on the West Florida Shelf using Growing Hierarchical Self-Organizing Maps. Oral presentation at the 85th AMS Annual meeting - Fourth Conference on Artificial Intelligence Applications to Environmental Science. San Diego, California, January 2005.

Liu, Y. and R.H. Weisberg (2005). Across-shelf structure of the ocean circulation on the West Florida Shelf. Poster presented at the Gordon Research Conferences - Coastal Ocean Circulation. New London, NH, June 5~10, 2005.

Liu, Y., and R.H. Weisberg (2006). Ocean current structures and sea surface height estimates across the West Florida Shelf. Poster presentation at the 13th Ocean Sciences Meeting, Honolulu, Hawaii, Feb 20-24, 2006.

Luther, M., S. Meyers, B. Galperin, S. Gilbert, V. Subramanian, J. Scudder, M. Vincent, R. Pribble, and T. Janicki, 2005. An Integrated Observing and Modeling System for Tampa Bay. Presented at the Oceans05 Conference, September 2005.

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Bay. Presented at the Estuarine Research Federation 18th Biennial Conference, Norfolk, VA, October 2005.

Sopkin, K., C. Mizak, S. Gilbert, V. Subramanian, M. Luther, and N. Poor, 2005. Comparison of estimates of air-water fluxes for Tampa Bay, Florida. Presented at the Estuarine Research Federation 18th Biennial Conference, Norfolk, VA, October 2005.

Weisberg, R.H. and L. Zheng: A numerical simulation of the hurricane Charley storm surge in the light of lessons learned from Tampa Bay" presented at 19th Governor's Hurricane Conference on 5/13/05 at Tampa, Florida.

Weisberg, R.H. and L. Zheng. An FVCOM simulation of the Tampa Bay estuary circulation. Presented at the 18th biennial conference of the Estuarine Research Federation, Norfolk VA., 10/19/05.

Wilson, M., M. Luther, S. Meyers, H. Holm, A. Linville, S. Gilbert, and V. Subramanian, 2005. Effects of Extreme Events on Residual Circulation and Residence Time for Tampa Bay, Florida. Presented at the Estuarine Research Federation 18th Biennial Conference, Norfolk, VA, October 2005.

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Luther, M. E. (2006). The US Integrated Ocean Observing System and the State of Florida. Presented to the Florida Technical Advisory Group for Coastal Ocean Monitoring, Florida Department of Environmental Protection, Tallahassee, FL, April 7, 2006.

Virmani, J. I. (2006). Hurricanes and Our Climate. Invited Talk at Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute Marine Quest. St. Petersburg, April 22, 2006.

Zheng, L.Y and R.H. Weisberg. Circulation of Tampa Bay driven by buoyancy, tides, and winds: An application of FVCOM. Presented on 5/23/05 at College of Environmental and Science Engineering, Ocean University of China, Qingdao, Shandong.

Zheng, L.Y and R.H. Weisberg. How estuaries work: A Charlotte Harbor example. Presented on 6/1//05 at East China Normal University, Shanghai.

Partners:
NOAA National Ocean Service Center for Operational Oceanographic Products and Services
NOAA National Data Buoy Center
NOAA National Weather Service West Florida Forecast Office
US Coast Guard
US Geological Survey
Florida Fish and Wildlife Conservation Commission/Fish and Wildlife Research Institute
Florida Department of Environmental Protection
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Florida Institute of Oceanography
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